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UNDERGRADUATE MATHEMATICS CLUBS.

EDITED BY R. C. ARCHIBALD, Brown University, Providence, R. I.

CLUB ACTIVITIES.

THE MATHEMATICS CLUB OF GREENVILLE COLLEGE, Greenville, Ill.

This club was organized in September, 1916, "for the purpose of arousing interest in mathematics and of taking up subjects not usually discussed in class work." There are 25 members this year and of these about 20 usually attend each meeting. At the open meeting, addressed by Professor Rietz of the University of Illinois, between 50 and 60 persons were present. The programs of the meetings planned for 1916–17 and 1917–18 were printed and the issue of the *Greenville College Bulletin* for November 1, 1917, reproduced the latter program and a group photograph of the club members of last year.

The club levies no regular dues but assesses its members for such necessary expenses as bringing speakers from out of town, printing, making cuts for the college annual, etc.

Officers: President, James Caroway '19; vice-president, James Dilbeck '18; secretary, Edna Lindh '20; treasurer, Gerald Bergman '19; 1st consul, Herschel Lintherland '18; 2d consul, Artemisia Watkins '19. The head of the department of mathematics, Professor Nelle Louise Ingels, and the consuls, constitute the program committee.

The programs for 1916–18 are as follows:

November 12, 1916: "The Correlation in Efficiency of Mathematics and other Branches in College" by Beryl Eales '17; "Determination of the Distance of the Earth to the Sun" by Harry Schwartz '20.

December 13: "Vocational Value of Mathematical Training" by William Treloar '18; "Lives of Philosophical Mathematicians" by Richard Donoghue '18; "Zeno's Arguments" by James Dilbeck '18.

January 10, 1917: "History and Development of Logarithms" by Artemisia Watkins '19; "Slide Rule" by Ira King '18.

February 17: Address by Edgar J. Townsend, Professor of Mathematics at the University of Illinois.

March 14: "Fourth Dimension" by Gerald Bergman '19; "Mathematics of Chemistry" by Wendell Griffith '17.

April 11: "Trisection of the Angle" by George Morland; "Squaring the Circle" by Ruth Hoffmann '18; "Duplication of the Cube" by Floyd Chase '17.

November 28, 1917: "The Function of Mathematics in Scientific Research" by James Caroway '19; "How to Study" by Edna Lindh '20.

December 8: "The Mathematical Treatment of the Data of Science" by Henry L. Rietz, professor of mathematical statistics at the University of Illinois.

January 9, 1918: "Non-Euclidean Geometry" by Gerald Bergman '19; "Hyperspace" by Harry Schwartz '20.

February 6: "Medieval Courses of Mathematics" by Herschel Lintherland '18; "Correlation of Efficiency in Mathematics and Efficiency in Other High School Branches" by Professor Ingels.

March 6: "Famous Problems of Antiquity" by Artemisia Watkins '19; "Value of Calculus" by Ruth Cochran '20.

April 2: "History and Significance of the Theory of Limits in Mathematical Study" by James Dilbeck '18.

THE WHITE MATHEMATICS CLUB AT THE UNIVERSITY OF KENTUCKY, Lexington, Ky.

Although this club was founded in the autumn of 1908 "it was not given its name till four years ago.[1] The club is composed of instructors, graduate students and students majoring in the department of mathematics. Its purpose is to create and foster a sympathetic and harmonious relationship among those working in the field of mathematics, to have its members review and present in brief papers the works of the leading mathematicians, to furnish a means for the systematic and detailed study of some standard work, and, in general, to stimulate the mathematical interests of its members." Meetings are held weekly. Number of members, 7.

Officers 1917–18: President, Professor P. P. Boyd; secretary-treasurer, Professor H. H. Downing.

The program is as follows:

October 31 and November 7: "War Mathematics" by Homer L. Reid Gr.

November 14: "An Account of Scientific Measurements of the Results of Instruction" by Professor Boyd.

November 21: "Fermat's Last Theorem and the Origin and Nature of Algebraic Numbers" [review of L. E. Dickson's article in *Annals of Mathematics*, 1917] by Professor E. L. Rees.

November 28: "A Problem suggested by the Mean Value Theorem" by Professor H. H. Downing.

December 5: "A Method of Constructing the Graph of Equations in which the Variables are Separated" by Professor E. L. Rees.

December 12: "Double Points of Rational Curves" [review of O. J. Peterson's article in this MONTHLY, 1917] by Vernon G. Grove Gr.

December 19: "The Graph of $f(x)$ for Complex Numbers" [review of A. F. Frumveller's article in this MONTHLY, 1917] by Harry R. Allen Gr.

THE MATHEMATICS CLUB OF THE UNIVERSITY OF NORTH CAROLINA, Chapel Hill, N. C.

The object of this club, which was organized in October, 1916, is "to promote interest in mathematics among the students and to bring them into closer touch with the faculty in a non-class-room way." Special effort is made to interest Sophomores and Freshmen in the club.

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[1] In honor of Professor James G. White, dean of men, at one time acting president, and for many years head of the department of mathematics in the university. He died in the summer of 1913 and Professor Boyd succeeded him as head of the department.

As a rule meetings are held monthly. There are now 25 members; attendance 15–20.

Officers, 1917–18: President, Professor William Cain; vice-president, Professor Archibald Henderson; secretary-treasurer, Instructor J. W. Lasley, Jr.

The program is as follows:

October 10: Election of officers; "The Principle of Duality" by Dr. A. W. Hobbs, instructor; there was also discussion by the secretary-treasurer of several problems that had been proposed to the society for solution.
November: "A Review of the Situation in Mathematics in the High Schools of North Carolina" by Instructor William W. Rankin.
December: no meeting.

THE MATHEMATICAL CLUB OF SMITH COLLEGE, Northampton, Mass.

This club was organized in October, 1899, "to discuss matters relating to mathematics." Each year it has nine regular meetings, two or more of which are social or of a business character. Membership is limited to students of the Junior and Senior classes majoring in mathematics. Of the 35 members about one third are Juniors. Average attendance, 24.

Officers, 1917–18: President, Professor Eleanor P. Cushing; vice-president, Sarah S. Powell '18; secretary, Elizabeth Walrath '18; treasurer, Ruth Bray '18.

The program for 1917–18 is as follows:

October 22: "Mathematics Used in Actuarial Work" by Professor Ruth Wood and Threasa Boden '18.
October 30: Business meeting; election of 11 new Senior members.
November 12: "Practical Use of Mathematics in Astronomy" by Vera Gushee, demonstrator in astronomy.
December 3: Business meeting; election of 6 new Junior members.
December 10: Christmas party.
January 7: "Mathematics as applied to Domestic Arts" by Margaret McClenathan '18; "Teaching of Mathematics" by Florence Putnam '18.

TOPICS FOR CLUB PROGRAMS.

3. ARITHMETICAL PRODIGIES.

There are many instances of individuals, often very young, endowed with a power of effecting extraordinary mental calculations. Some had little or no education; the greatest of them all was stupid in everything but calculation, even including mathematics. Others attained to eminence in some field of science. Many had exceptional figure memory of either the visual or the auditory type. The rather small body of authenticated material, collected in part by commissions of scientific bodies appointed to test various prodigies, has been the basis of considerable study by psychologists and others. A few names and facts may be recalled.

Because of exceptional calculating ability Jedediah Buxton, an Englishman of the eighteenth century, was tested by the Royal Society. George P. Bidder (1806–1878),[1] son of an English stone-mason, could multiply twelve figures by twelve figures, and perform complicated problems of compound interest.[2] He became a noted engineer and one of his great works was in connection with the designing of the Victoria Docks, London. Zerah Colburn (1804–1840), son of a Vermont farmer, seemed to possess to a remarkable degree the ability to factor numbers. In his autobiography (Springfield, Mass., 1833) occurs the following paragraph concerning an exhibition in London when 8 years of age: "It had been asserted . . . that 4,294,967,297 ($= 2^{32} + 1$) was a prime number. . . . Euler detected the error by discovering that it was equal to 641 × 6,700,417. The same number was proposed to this child who found out the factors by the mere operation of his mind." In GRAVES, *Life of Sir William Rowan Hamilton*,[3] there are some interesting passages concerning Hamilton's connections with "that Zerah Colburn, the wonderful American boy who used to calculate with such astonishing rapidity." Another son of a Vermont farmer, who lived within forty miles of Colburn's birth-place, was Truman Henry Safford (1836–1901) whom Simon Newcomb has characterized as a "most wonderful genius." At the age of 6 he was able mentally to multiply four figures by four figures and to extract square and cube roots of numbers of nine and ten figures. Newcomb records that "a Committee of the American Academy of Arts and Sciences was appointed to examine him. It very justly and wisely reported that his arithmetical powers were not in themselves equal to those of some others on record, especially Zerah Colburn, but that they seemed to be the outcome of a remarkable development of the reasoning power."[4] Safford graduated from Harvard and became an astronomer. From 1876 until his death he was professor of astronomy in Williams College. Like Ampère the French physicist who was also a calculating prodigy, he had a wide range of interests and an encyclopedic memory. "Chemistry, botany, philosophy, geography as well as mathematics and astronomy, were included in his field of study." Another French prodigy was Henri Mondeux who was tested on behalf of the Academy of Sciences of the Institute of France by a committee consisting of Arago, Sturm, Cauchy and Liouville.[5]

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[1] *Dictionary of National Biography*, Vol. 5, London, 1886.

[2] He has left an excellent account of his methods in *Proceedings of the Institution of Civil Engineers*, London, 1856, vol. 15, pp. 251 ff.

[3] Volume 1, London, Longmans, 1882, pp. 77 ff. It may be noted that there is a brief reference to Colburn in De Morgan, *Budget of Paradoxes*, second edition, Chicago, Open Court, 1915, Vol. 1, p. 86.

[4] For this passage and other interesting facts see S. Newcomb, *The Reminiscences of an Astronomer*, Boston, Houghton, Mifflin, 1903, pp. 67–69. A biographical sketch may be found in *National Cyclopedia of American Biography*, vol. 13, 1906.

[5] For the report by Cauchy see Cauchy, *Œuvres complètes*, 1re série, tome 5, Paris, 1885, p. 493 f. (reprinted from *Comptes Rendus*, tome 11, pp. 820 and 952). There are biographies of Mondeux by Barbier (1841) and Jacoby (1846).

In more recent times the Italian calculator Jacques Inaudi (born 1867), who has frequently exhibited in the United States, was investigated in 1892 by a French Institute commission composed of Darboux, Poincaré, Tisserand and Charcot.[1] Périclès Diamandi (born 1868), a Greek, was tested by the same commission in 1893. The famous German mathematician Carl Friedrich Gauss (1777–1855) tells us that at the age of three he corrected calculations in connection with his father's payroll. But the most wonderful arithmetical prodigy of all time was Zacharias Dase (1824–1861) who was born in Hamburg.[2] He is known to have multiplied two 100-figure numbers in $8\frac{3}{4}$ hours and to have extracted the square root of a 100-figure number in 52 minutes. His non-mental computations included the determination of the value of π to 200 decimal places, a labor of scarcely two months;[3] the computation of a 7-place table of natural logarithms of numbers;[4] and factor tables (performed at the instigation of Gauss) for the seventh and eighth million (the latter not quite complete) and parts of the ninth and tenth million.[5]

Many facts concerning these and other prodigies, together with a discussion of psychological questions involved, and full bibliographies, may be found in the following works: E. W. Scripture, "Arithmetical Prodigies," *American Journal of Psychology*, Worcester, 1891, Vol. 4, pp. 1–59; F. D. Mitchell, "Mathematical Prodigies," *American Journal of Psychology*, 1907, Vol. 18, pp. 61–143 (includes corrections of some of Scripture's slips); A. Binet, *Psychologie des grands calculateurs et joueurs d'échecs*, Paris, Hachette, 1894, 8 + 364 pp. (portraits of Inaudi and Diamandi); G. E. Müller, *Zur Analyse der Gedächtnistätigkeit und des Vorstellungsverlaufs*, 1. und 3. Teile, Leipzig, Barth, 1911–13 (*Zeitschrift für Psychologie und Physiologie der Sinnesorgane*, 5. und 8. Ergänzungsbände)—especially 1. Teil, pp. 177–237; W. G. Smith, "Notes on the Special Development of Calculating Ability," pp. 60–68 of *Modern Instruments and Methods of Calculation. A Handbook of the Napier Tercentenary Exhibition.* Edited by E. M. Horsburgh, London, Bell [1914]; and P. J. Möbius,[6] *Ueber die Anlage zur Mathematik*, mit 51 Bildnissen. Leipzig, Barth, 1900—"Ueber die Rechenkünstler," pp. 66–76.

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[1] The report by Darboux together with a biographical sketch by Charcot was published in *Comptes Rendus*, 1892, vol. 114, pp. 1329–1338.

[2] There is a biographical sketch of Dase in *Allgemeine Deutsche Biographie*, Band 4, Leipzig, 1876. His name is sometimes spelled Da*h*se.

[3] *Crelle's Journal*, 1844, Band 27, p. 198. With the value of π on this page is printed an extract from an interesting letter written by S. Strasznicky of Vienna.

[4] Z. Dase, *Tafel der natürlichen Logarithmen*, Vienna, 1850 (reprinted from *Annals* of the Vienna Observatory for 1851). *Cf.* J. W. L. Glaisher's article on "Table, Mathematical" in the eleventh edition of the *Encyclopædia Britannica.*

[5] The tables for the seventh million were printed at Hamburg in 1862 and the tables for the eighth and ninth millions, completed by H. Rosenberg, were published at the same place in 1863 and 1865 respectively. The tenth million by Dase and Rosenberg has not been published but The Carnegie Institution of Washington issued in 1909 a *Factor Table for the First Ten Millions* by D. N. Lehmer. The introduction to this table lists only 7 errors in Dase's seventh million table (1862) but over 130 in the volumes in which Rosenberg collaborated.

[6] A doctor; grandson of the well-known astronomer and mathematician.

In H. A. BRUCE, "Lightning Calculators, a study in the psychology of harnessing the subconscious," *McClure's Magazine*, 1912, Vol. 39, pp. 586–596, there are portraits of W. J. Sidis, G. Bidder, H. T. Safford, Gauss, Griffith (an Indiana calculator) and Inaudi. Another brief sketch is G. A. MILLER, "Mathematical Prodigies," *Science*, new series, Vol. 26, pp. 628–30, 1907 (also *Scientific American Supplement*, Vol. 65, p. 51, 1908).

4. PTOLEMY'S THEOREM AND FORMULÆ OF TRIGONOMETRY.

Ptolemy of Alexandria, celebrated mathematician, astronomer and geographer, was a native of Egypt and flourished about the middle of the second century of the Christian era.[1] His great treatise on astronomy is usually known as the *Almagest*—a name derived from an Arabic form of its title. The work is divided into thirteen books.[2] In discussing matters pertaining to plane and spherical trigonometry in the first book Ptolemy introduces as a lemma what is now known as Ptolemy's Theorem: "The rectangle contained by the diagonals of any quadrilateral inscribed in a circle is equal to the sum of the rectangles contained by the pairs of opposite sides" (Heiberg's edition, volume 1, pages 36–7). An English translation of Ptolemy's proof of his theorem is given in T. L. HEATH, *The Thirteen Books of Euclid's Elements*, Vol. 2, Cambridge University Press, 1908, pages 225–6.

From this theorem Ptolemy readily derived the equivalent of the formulæ:

$$\sin(\alpha \pm \beta) = \sin\alpha\cos\beta \pm \cos\alpha\sin\beta$$

and

$$\sin\frac{\alpha}{2} = \left(\frac{1-\cos\alpha}{2}\right)^{1/2}.$$

Of French and English discussions of similar applications of the theorem the following may be noted: L. N. M. CARNOT, (*a*) *De la corrélation des figures de géométrie*, Paris, 1801, pp. 83f., 95f.; (*b*) *Géométrie de position*, Paris, 1803, pp. 151ff.; W. A. WHITWORTH, *Mathematical Gazette*, London, 1904, Vol. 3, pp. 6–7; J. JUHEL-RÉNOY, *Bulletin des sciences mathématiques et physiques élémentaires*, Paris, 1908, Vol. 13, p. 113; A. G. BURGESS, "Ptolemy's Theorem and Certain Trigonometrical Formulæ," *Mathematical Notes*, Edinburgh, 1910, No. 4, pp. 42–3; and A. BABBITT, *School Science and Mathematics*, 1917, Vol. 17, p. 784.

Among the many proofs of Ptolemy's Theorem reference may be given to two others: (*a*) by inversion in F. G. M., *Exercices de géométrie*, 5e éd., Paris, Gigord, 1912, pp. 104–5; (*b*) by means of the anharmonic relation

$$E(BACD) + E(BCAD) = 1,$$

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[1] *Cf.* the article on Claudius Ptolemy in *Encyclopædia Britannica*, eleventh edition.

[2] The best text has been edited by J. L. Heiberg: *Syntaxis Mathematica*, 2 vols., Leipzig, Teubner, 1898–1903. The catalogue of stars contained in the seventh and eighth books was published by the Carnegie Institution of Washington in 1915. For a commentary on the *Almagest* see Delambre, *Histoire de l'astronomie ancienne*, tome 2, Paris, 1817, pp. 67–410 and 36–44.

where A, B, C, D are the vertices of the inscribed quadrilateral, and E any other point on the circle (J. JUHEL-RÉNOY, *Nouvelles annales de mathématiques,* 1906, Vol. 65, p. 12; *cf.* J. L. COOLIDGE, *A Treatise on the Circle and on the Sphere,* Oxford, Clarendon Press, 1916, p. 315).

By taking account of the directions of line segments, Moebius arrived at the generalization of Ptolemy's Theorem:

$$AB \cdot CD + AC \cdot DB + AD \cdot BC = 0,$$

where A, B, C, D may be arranged in any way whatever on the circle.[1] The discovery that this relation is true when the points are collinear is usually attributed to Euler, but the result was known to a tenth-century Arab, El-Sābī (*Bibliotheca Mathematica,* 3. Reihe, Vol. 8, 1907–8, p. 24).

Carnot generalized Ptolemy's Theorem to apply to the case of an inscribed polygon (*Géométrie de position,* p. 273). For John Casey's generalization (1866) see his *Sequel to Euclid,* London, Longmans, 1900, pp. 103–4, and J. L. COOLIDGE, *A Treatise on the Circle,* etc., p. 38.

Amplification of some of the ideas presented in sources indicated above may be found in: J. L. COOLIDGE, *A Treatise on the Circle,* etc., p. 138; X. ANTOMARI, "Relation entre les distances mutuelles: 1° de quatre points situés sur un même cercle; 2° de cinq points situés sur une même sphère," *Nouvelles annales de mathématiques,* 1882, tome 41, pp. 462–64; A. KRAHÉ, "Sur les relations de Ptolémée et de Feuerbach," *Mathesis,* 1898, tome 18, pp. 83–84; W. F. MEYER, "Über den Ptolemäischen Satz," *Archiv der Mathematik und Physik,* 1903, 3. Reihe, Band 7, pp. 1–15; M. STUYVAERT, "Conséquences diverses d'une formule d'algèbre; leurs interprétations géométriques," *L'Enseignement mathématique,* 1906, tome 8, pp. 282–290; and MERRIFIELD, *Proceedings of the London Mathematical Society,* 1881, Vol. 12, p. 214.

5. PAPER FOLDING.

In 1893 an Indian, T. Sundara Row, published a little volume of 120 pages[2] setting forth, very ingeniously, many exercises in paper folding which constitute an interesting chapter in mathematical recreations. There are constructions for: (*a*) the regular pentagon, hexagon, octagon, nonagon, decagon, dodecagon, and pentedecagon; (*b*) points on the conic sections and on such curves as the cissoid, the conchoid of Nicomedes, the witch of Agnesi, the cubical parabola, the lemniscate, and the cycloid. Many theorems of Euclidean and projective geometry are also discussed.

Apparently without knowledge of Sundara Row's work H. Wiener gave also in 1893 an account of the construction of the regular convex polyhedra by paper folding.[1] When it is recalled that for over a century the simple method of constructing such polyhedra has been given in text-books, it appears that Wiener's additional contribution consisted almost wholly in constructing, by paper folding, equilateral triangles, squares, and pentagons—a very small portion of Sundara Row's discussion. This fact is not made clear in Klein's remark on page 42 of the English edition of his *Famous Problems in Elementary Geometry*, Boston, Ginn, 1897.

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[1] A. F. MOEBIUS, "Die Theorie der Kreisverwandtschaft, etc.," 1855; *Gesammelte Werke,* Band 2, Leipzig, 1885, pp. 280, 307.

[2] *Geometrical Exercises in Paper Folding.* By T. Sundara Row . . . Madras, Addison and Co. A new edition with slight modifications of the proofs and the addition of a "considerable number of half-tone reproductions of actual photographs instead of the line-drawings of the original" was brought out by W. W. Beman and D. E. Smith in 1901 (Chicago, Open Court).

Finally, reference may be given to a note by Fitz Patrick on "La géométrie par le pliage et découpage du papier" in W. W. R. BALL, *Récréations mathématiques et problèmes des temps anciens et modernes*, troisième partie, Paris, Hermann, 1909, pp. 341–360; to *Messenger of Mathematics*, 1905, Vol. 34, pp. 142–3; and to *L'Education Mathématique.*

NOTES AND NEWS.

EDITED BY D. A. ROTHROCK, Indiana University, Bloomington, Indiana.

Dr. J. B. ROSENBACH has been appointed instructor in mathematics at the University of New Mexico.

Dr. GOLDIE P. HORTON has been appointed instructor in mathematics at the University of Texas.

Dr. G. H. LIGHT, of the University of Colorado, has been promoted to an assistant professorship of mathematics.

Dr. E. W. PONZER, assistant professor of applied mathematics at Leland Stanford University, died on December 20, 1917, as a result of an accidental gunshot wound.

Mr. J. J. TANZOLA, until recently an instructor in mathematics at the U. S. Naval Academy, is now a private with the 305th Machine Gun Battalion, Company C, at Camp Upton, Long Island.

Mr. FREDERICK WOOD, instructor in mathematics at the University of Wisconsin and a charter member of the Association, is now a lieutenant with the 328th Field Artillery at Camp Custer, Michigan.

Dr. J. E. DAVIS, instructor in mathematics at Pennsylvania State College, is enrolled in the 313th Infantry at Camp Meade, Md.

The University of California has been, since May 21, 1917, conducting a school of military aëronautics, in which about five hundred cadets are being trained in an eight weeks' course in flying. Professor B. M. WOODS, of the department of mathematics, a charter member of the Association, is directing the instruction in this school.

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[1] *Katalog mathematischer und mathematisch-physikalischer Modelle, Apparate und Instrumente.* Nachtrag. Herausgegeben von W. Dyck. München, Wolf, 1893, pp. 52–54.